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I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

I also certify that the attached copy of the request for grant of a Patent (Form 1/77) bears an amendment, effected by this office, following a request by the applicant and agreed to by the Comptroller-General.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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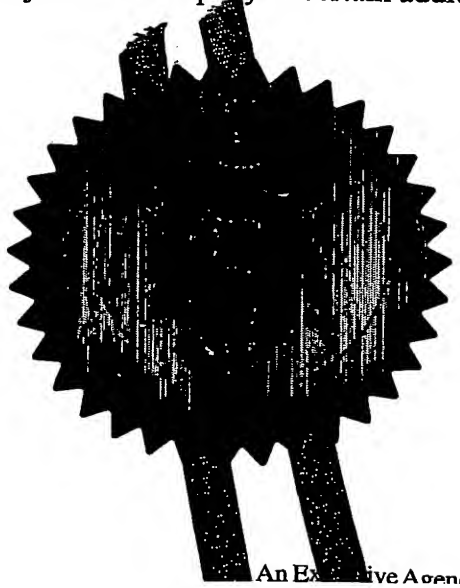

Signed D Evans.

Dated 2 April 2004

Patents Form 1/77

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P01/7700 0320995.4

THE PATENT OFFICE
J
- 9 SEP 2003
NEWPORT

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference
BB-FRONT

2. Patent application number
(The Patent Office will fill in this part)
0320995.4 - 9 SEP 2003

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*
ADRIAN MICHAEL GRIFFITHS,
WATER SIDE,
PRESTON BAGOT,
HENLEY-IN-ARDEN,
WARKS B95 5ED

Patents ADP number *(if you know it)*
7016485002

If the applicant is a corporate body, give the country/state of its incorporation
N/A

4. Title of the invention
A FRONT SUSPENSION WITH HIGH ANTI-BRAKE DIVE FOR A BICYCLE

5. Name of your agent *(if you have one)*
ANTHONY CURTIS & Co.
1 OLTON BRIDGE
245 WARWICK ROAD
SOLIHULL
B92 7AH.

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

see 51/77 dated 30/3/04

Patents ADP number *(if you know it)*
00002188001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

NO

Patents Form 1/77

9. Enter the number of sheets for a[redacted] the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	0
Description	5
Claim *(s)*	0
Abstract	0
Drawing *(s)*	0

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	N/A
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature Adrian Griffiths Date 7th Sept 2003

12. Name and daytime telephone number of person to contact in the United Kingdom ADRIAN GRIFFITHS 0121 482 3632

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.

b) Write your answers in capital letters using black ink or you may type them.

c) If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.

d) If you have answered 'Yes' Patents Form 7/77 will need to be filed.

e) Once you have filled in the form you must remember to sign and date it.

f) For details of the fee and ways to pay please contact the Patent Office.

A FRONT SUSPENSION WITH HIGH ANTI-BRAKE DIVE FOR A BICYCLE ESPECIALLY SUITED TO AN BICYCLE WITH INTERCONNECTED SUSPENSION

Terminology

Coupling ; When one parameter influences another, the parameters are said to be coupled.
Interconnection ; A means of connecting the front and rear suspensions in such a way that vertical motion of one influences vertical motion of the other.
Anti-brake dive ; A property of the front suspension which describes its ability to resist deflection due to weight transfer effects when the brakes are applied by reacting force through its linkages rather than through its springs.
Contact patch trajectory ; The path of the contact patch centre as seen from the side view as the suspension articulates from rebound to bump. This characteristic is closely associated with anti-brake dive (for front suspensions) and anti-brake-lift (for rear suspensions).
Contact patch trajectory angle. The angle to the horizontal of the contact patch trajectory.
In-phase motion ; When the front and rear wheels both move vertically and in the same direction.
Virtual centre ; An instantaneous centre of rotation of an object that is defined by the orientation of the linkages that locate it.

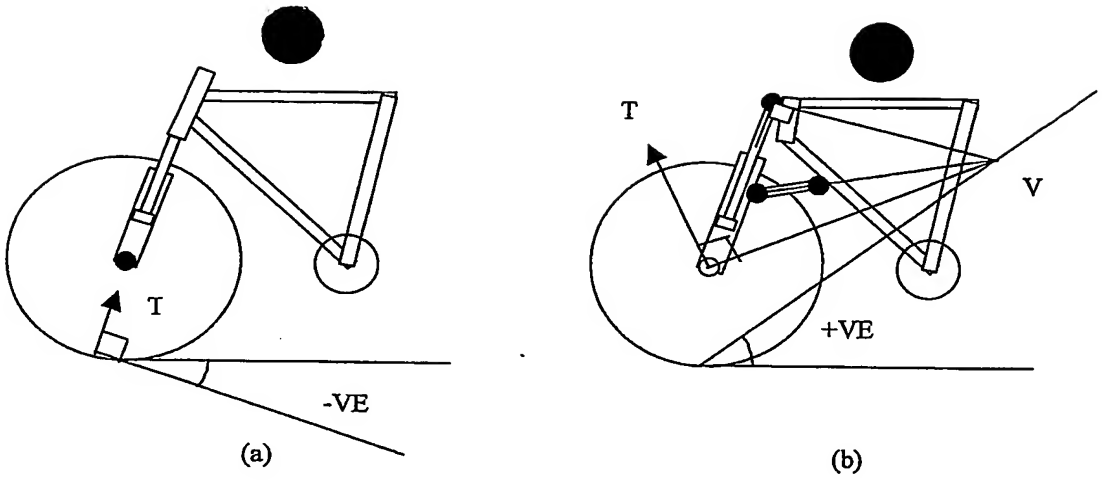
Background

When the brakes are applied on a bicycle with suspension, the weight transfer onto the front wheel resulting from the deceleration of the bike and rider will tend to cause the bicycle to dive i.e. the front suspension compresses. The suspension will either counter or augment this tendency by virtue of a property known as anti-dive. The more positive the anti-dive the more the suspension will tend to counter the diving tendency.

Diagrams (a) and (b) below illustrate the front suspension behaviour that is typical of most currently in the market. They also serve to illustrate the compromises inherent in most current front suspension types.

Diagram (a) shows a conventional fork arrangement whereby the wheel is located on one or two parallel telescopic dampers and hence the wheel is constrained to move in a direction parallel to the axes of the dampers (direction T in diagram a). The level of anti-dive corresponding to this arrangement is negative, that is to say that the suspension will tend to promote dive when the brakes are applied over and above that which would occur solely due to weight transfer effects. The trajectory of the wheel however is favourable in terms of compliance behaviour owing to the fact that the wheel is allowed to move backwards and upwards when the suspension encounters a bump. It will be noted that for this concept, the trajectory angle of the wheel is inextricably linked to the anti-dive angle, being at 90 degrees to one another.

The concept shown in diagram (b) is a less common arrangement whereby the linkages have been aligned in such a way as to provide a degree of positive anti-dive as defined by a line connecting the contact patch of the tyre with the virtual centre V in diagram b, in turn defined by the orientation of the suspension linkages. Once again the trajectory angle is at right angles to the anti-dive angle and, as a consequence the trajectory is unfavourable in terms of compliance being upwards and forwards in direction. The upwards and forwards trajectory will tend to increase shock transmission to the rider when traversing bumpy ground. This increase in shock transmission corresponds to the reaction to the forward component of the wheel's acceleration.



The invention

The front suspension system proposed overcomes the compromise between wheel trajectory angle and anti-dive angle by mounting the brakes independently on a pivot axis that is in line with the rotational axis of the wheel. The brake torque is then reacted independently through a separate linkage which does not perform a constraining influence on the wheel itself. Though a small number of front suspensions on the market use the same approach, the specific arrangement described here is novel.

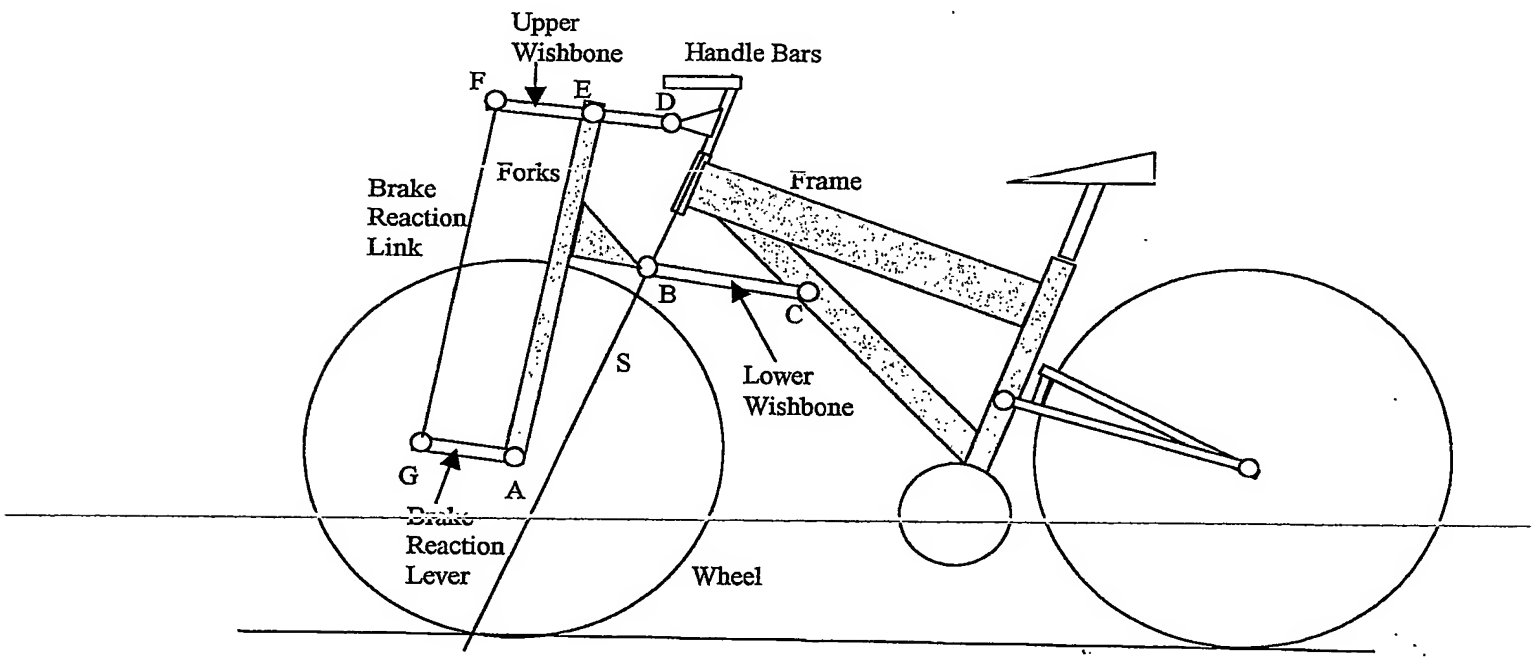


Diagram (c)

Diagram (c) shows the general layout of the specific arrangement.

The parts (referring to diagram c)

GA	Brake reaction lever
ABE	Forks
FG	Brake reaction link
BC	Lower wishbone
FED	Upper wishbone

The Joints

- The handlebars are connected to the frame by a hinge along axis S. This axis also passes through B defining the steering axis of the front suspension.
- The wheel is connected to the forks via a hinge having an axis perpendicular to the page at A (in the conventional way).
- The forks are connected to the lower wishbone at B via a spherical joint.
- The lower wishbone is connected to the frame via a hinge having an axis perpendicular to the page at C.
- The upper wishbone is connected to the handlebars via a hinge having an axis perpendicular to the page at D.
- The forks are connected to the upper wishbone via a universal joint (or equivalent) having an axis along the line EA. This allows relative angular displacement to take place between the forks and the upper wishbone other than along axis EA.
- The brake reaction lever is connected to the forks via a hinge having an axis perpendicular to the page at C. Note although this is located at the same place as the wheel bearing and is oriented is the same direction, it is a separate bearing. The likely configuration is the two bearing are concentric, the wheel bearing running down the centre of the brake reaction lever bearing.
- The brake reaction link is connected to the brake reaction lever at G and the upper wishbone at F via simple hinges or spherical joints.

The front brake unit is either a disc or drum unit.

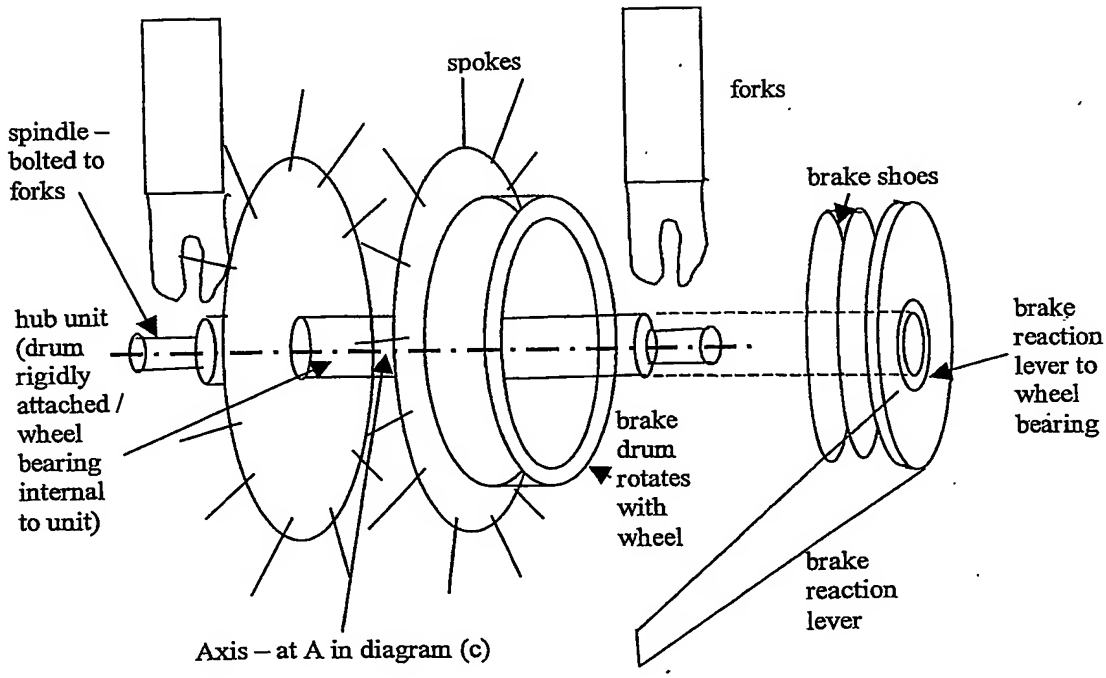


Diagram (d)

Diagram d shows a possible arrangement of the wheel bearing and the brake reaction lever bearing aligned concentrically

When the brakes are applied, the brake torque is reacted by the brake reaction link. The brake reaction link will be in tension, transmitting a downward force on the upper wishbone at point F. This will result in an upward force transmitted through the upper wishbone at D. The magnitude of this force will depend on the relative lengths of the upper wishbone and the brake reaction lever and the location of point E along the upper wishbone.

By such means the suspension can be tuned to provide significant anti-dive independent of the wheel trajectory angle. In diagram c, the trajectory would be upwards and rearwards as would be desired.

A further advantage of this specific arrangement is that the loads in the brake reaction link will always be tensile so long as the brakes are applied whilst travelling in the forwards direction. Although the brakes may be required to operate in reverse to small degree (e.g. stopping the bicycle from rolling backwards on a hill), the forces will be small. The link can therefore be made from narrow gauge material.

The arrangement is particularly well suited to interconnected arrangements for which high levels of anti-brake dive are required. Most conventional means of achieving this would lead to adverse wheel trajectory and poor compliance performance. Additionally the fact that the lower wishbone is constrained to operate in the plane of the frame is sympathetic to the requirements of interconnection. In order to interconnect the front and rear suspensions in a manner that does not corrupt or interfere with the steering system, the interconnection parts must be actuated by a component that does not substantially move as a result of turning the steering. In other words the interconnection should be decoupled from the steering. The lower wishbone is ideal for this task.

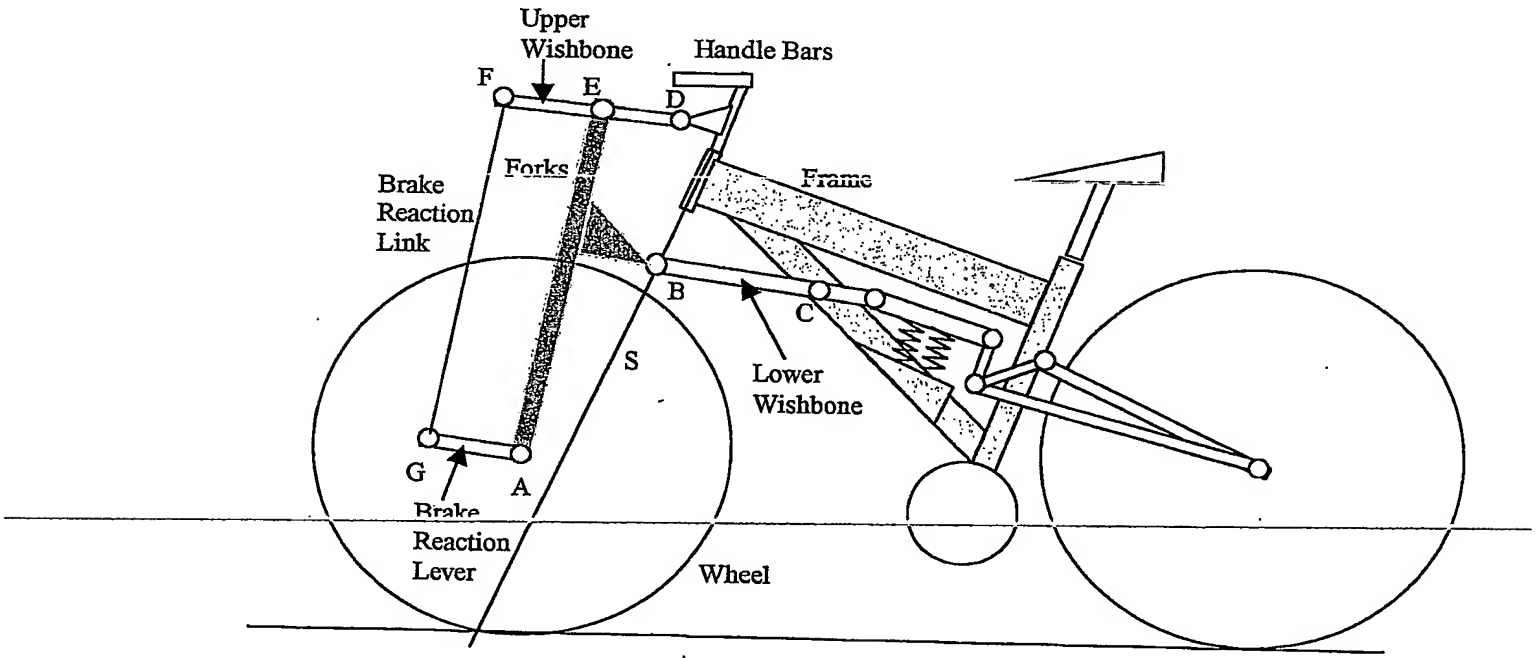


Diagram (e)

Diagram (e) shows a possible arrangement for an interconnected suspension arrangement. It can be seen that in addition to the interconection mechanism being decoupled from the steering system, this arrangement also allows the wheel trajectory to be decoupled from the anti-dive in the method described above. In order to do this it is necessary for the linkage through which the braking reaction

forces are transmitted (in this case the upper wishbone) to rotate with the steering system, in contrast to the lower wishbone which does not.

Hence the best possible solution can be found. The anti-dive, wheel trajectory and the interconnection mechanism can all be tuned independently of one another.